



Understanding of intra-operative tourniquets amongst orthopaedic surgeons and theatre staff – a questionnaire study

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ABSTRACT

INTRODUCTION Pneumatic tourniquets are used frequently in orthopaedic theatres to provide a bloodless field whilst operating on the extremities. Their use has given rise to complications and preventable damage due to over-pressurisation and prolonged application. We designed a questionnaire to assess the knowledge on tourniquet use among operating department assistants (ODAs) and specialist registrars (SpRs) in orthopaedic surgery.

SUBJECTS AND METHODS A questionnaire was constructed using set guidelines from the Association of periOperative Registered Nurses (AORN) for recommended practice of tourniquet application. This was distributed to orthopaedic registrars with varying levels of experience and ODAs from five different NHS hospitals. The unpaired, two tailed *t*-test was used to test for statistical significance of results.

RESULTS A total of 54 completed questionnaires were collected for analysis. The study population included 29 orthopaedic SpRs and 25 ODAs. The mean score for the orthopaedic SpRs as a group was 41.3% (SD 6.85; range, 29.0–54.8%). The mean score for the ODAs was 46.7% (SD 9.64; range, 23.3–62.9%) with a *P*-value of 0.024.

CONCLUSIONS Most surgeons are taught how to use pneumatic tourniquets by their senior colleagues as no formal teaching is given. Most of the complications are infrequent and preventable. However, their consequences can be devastating to the patient with medicolegal implications. Our results show suboptimal knowledge of tourniquets and their use among SpRs and ODAs. This study highlights the need for amendments in training to improve the knowledge and awareness of medical practitioners on the application and use of tourniquets to prevent adverse events and improve patient safety.

KEYWORDS

Tourniquets – Education – Extremities – Orthopaedics – Ischaemia

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A tourniquet (derived from the French word *tourner*, to turn) aids surgeons by providing a bloodless surgical field and thus facilitates identification of structures, thereby reducing operating time and reducing surgical complications.

The extensive use of tourniquets in surgery has been accompanied by continuing reports of limb paralysis, nerve damage, and other injuries. Many of the reported cases of preventable damage have been due to over-pressurisation¹ and prolonged application.

Pneumatic tourniquets are used frequently in orthopaedic theatres. Although surgeons have formal examinations which assess knowledge in various aspect of clinical work (*i.e.* MRCS, FRCS), there is no formal examination to

test knowledge on tourniquet use. It is usually the operating department assistants (ODAs) that apply the tourniquet, set the pressure and remove it after the operation. However, it is the surgeon who is ultimately responsible for any consequences that arise from its use.²

In this study, a questionnaire was given to orthopaedic specialist registrars (SpRs) and ODAs in the Mersey and London Deaneries which assessed knowledge on tourniquet use. Its aim was to see how the two groups compared with regards to knowledge on tourniquet use and their potential complications. Results from this study could help improve the curriculum set out for surgeons with regards to tourniquet use, and thus reduce the risk of adverse events.

Subjects and Methods

A questionnaire (Appendix 1 online only) was constructed using guidelines from the Association of periOperative Registered Nurses (AORN) for recommended practice of tourniquet use in the US.⁵ These guidelines were made effective in the US on 1 January 2007.

The key points that the questionnaire aimed to assess amongst the study population were:

1. Gases not used in tourniquet cuff inflation.
2. Cuff size, shape, position and degree of overlap.
3. Importance of preventing fluid leakage beneath cuff.
4. Tourniquet repositioning.
5. When not to use limb exsanguination before inflation.
6. Contra-indication to pneumatic tourniquet use.
7. Limb occlusion pressure and its application in setting tourniquet pressure (the minimum cuff pressure necessary to stop arterial blood flow distal to the cuff).
8. Safe inflation time.
9. Metabolic effects of tourniquet use.
10. Complications of tourniquet use.
11. Regional anaesthetic use and tourniquet application.
12. Reperfusion during prolonged tourniquet use.

The questionnaire was in the form of 25 short-answer questions, with a maximum of 67 marks available. This method of data collection was used as it was felt that a multiple choice type questionnaire would introduce guess work on the part of the candidate.

The questionnaire was given to orthopaedic registrars with varying levels of experience and ODAs from five different NHS hospitals.

The completed questionnaires were marked by one of the authors (AS) and the results were exported to Microsoft Excel for analysis.

Statistical analysis

The unpaired, two tailed *t*-test was used to test statistical significance. A *P*-value less than 0.05 was considered statistically significant.

Results

A total of 54 completed questionnaires were collected for analysis. The study population included 29 orthopaedic SpRs and 25 ODAs. Orthopaedic SpRs were categorised according to their year of training (Table 1). The ODAs did not report their level of experience.

Table 1 Composition of orthopaedic registrars completing the questionnaire

Orthopaedic registrar	Number of completed questionnaires
Year 1	4
Year 2	3
Year 3	5
Year 4	8
Year 5	8
Year 6	1

Table 2 Mean scores for orthopaedic registrars

Orthopaedic registrar	Mean score % (SD)
Year 1	41.5 (9.71)
Year 2	34.4 (2.46)
Year 3	42.6 (5.30)
Year 4	41.9 (5.78)
Year 5	40.7 (7.30)
Year 6	53.2
All registrars	41.3 (6.85)

The mean score for the orthopaedic SpRs as a group was 41.3% (SD 6.85; range 29.0–54.8%). The mean score for the ODAs was 46.7% (SD 9.64; range 23.3–62.9%). The difference between the mean scores for each group was found to be statistically significant (*P* = 0.024).

The highest percentage on the questionnaire in the orthopaedic SpR group was achieved by one Year 6 candidate, 53.2%. The lowest mean score for the orthopaedic SpRs was for the Year 2 candidates, 34.4% (Table 2).

Discussion

The tourniquet is routinely used in operating theatres in the UK. If used properly, the tourniquet is safe and invaluable to the surgeon and anaesthetist, and helps improve patient outcome by reducing blood loss and operating time.¹ Complications from tourniquet use are infrequent and preventable. However, when they do occur they can be clinically devastating to the patient and can have significant medicolegal implications.¹

Our results show that the mean questionnaire score was significantly higher (46.7%) among ODAs compared to orthopaedic registrars (41.3%; *P* = 0.024). However, the average scores for each group were lower than would be

expected from individuals that use such devices on a regular basis.

The questionnaire used in this study was constructed using the AORN guidelines.⁵ Though it is not a validated tool for assessing knowledge, the questions are derived from the guidelines and marked appropriately.

Most surgeons learn how to use pneumatic tourniquets, as with many others skills in surgery, by instruction from their senior colleagues. There is no formal teaching in the curriculum on the use of tourniquets, despite it being examined in the FRCS (Tr & Orth), and instruction manuals are infrequently referred to or never read at all.

The literature yields little on the practice of tourniquet use among surgeons. Kalla *et al.*⁴ conducted an e-mail survey analysing trends in tourniquet use among orthopaedic surgeons in North America. They found that 3.4% rarely or never use a tourniquet and 2.5% use an Esmarch bandage tourniquet at the ankle. Most used pneumatic ankle cuffs (92% use; 27% use exclusively); many also used thigh cuffs (69%) and some also use calf cuffs (15%). Most thigh-cuff users (62%) experience problems with cuff fit sometimes or often. All but three respondents exsanguinate the limb before tourniquet inflation. Specific devices used for exsanguination varied among surgeons. Most commonly used tourniquet pressures range from 200–350 mmHg at the ankle and 200–351 mmHg for the thigh (64% use pressures between 301–350 mmHg). Only 7% of respondents considered limb occlusion pressure when selecting tourniquet cuff pressure.⁴ This is also highlighted in our survey. No individual from either the orthopaedic SpR or the ODA groups could correctly define limb occlusion pressure or knew its application when calculating the pressure setting for the tourniquet.

Approximately 10% of respondents have either experienced or learned of skin and nerve injuries secondary to lower extremity tourniquet use at any level. This showed a lack of consensus on various aspects of tourniquet uses. The authors concluded that there is a need for standard guidelines on tourniquet use.

Another study carried out by Younger *et al.*⁵ attempted to establish trends in tourniquet use by surveying members of the American Orthopaedic Foot and Ankle Society (AOFAS). Specific enquiry was made regarding the type of tourniquet being used, its location, and cuff pressures being employed.⁵ Cuff pressures most commonly used were 301–350 mmHg for thigh cuffs (49% of thigh cuff users) and

201–250 mmHg for calf and ankle cuffs (52% of calf cuff users, 66% of ankle cuff users).⁵ A substantial number of foot and ankle surgeons who use calf and ankle cuffs frequently use pressures above 250 mmHg (41% of calf cuff users, 19% of ankle cuff users).⁵ Only 9% use limb occlusion pressure when determining cuff pressure.⁵ They concluded that cuff pressures being used were higher than that recommended in the literature. They also claimed that using limb occlusion pressure measurements could help reduce tourniquet related complications by reducing cuff pressure.

Study limitations

The limitations of this study are sample size and questionnaire itself not being UK-derived and not validated. Future studies could address these points.

Conclusions

The use of tourniquets is mostly governed by individual practitioner preferences. This is because practice guidelines to minimise complications and risk are limited.⁶ It is important that healthcare professionals, in particular the surgical team, know how to use pneumatic tourniquets correctly and are aware of the risk and complications associated with its use, since most surgeons apply the tourniquet cuff themselves.⁴

This study highlights the need for amendments in training to improve the knowledge and awareness to prevent adverse events and improve patient safety.

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